20,000 OHMS/VOLT VOM

83 Y 140

ASSEMBLY MANUAL

knight-kit®

HOW TO BUILD THE KNIGHT VOM

The improved circuit design of the KNIGHT VOM assures a sensitive and accurate test instrument for the radio-TV serviceman, the laboratory technician, or the amateur. You may measure any AC or DC voltage found in radio and electronics work up to 5000 volts. The input resistance for DC scales is 20,000 ohms per volt. This enables you to read voltages in high impedance circuits without interfering with the circuit. For AC voltage measurements it is 5000 ohms per volt. Direct currents may be measured up to 10 amperes.

There are three resistance ranges. Center scale readings are at 12, 1200, and 120,000 ohms. All multipliers are 1% precision resistors, which assure accurate measurements for the life of the instrument.

Check all of the parts against the Parts List as you unpack the VOM kit. If you are unable to identify some of the parts by sight, locate them on the pictorial diagrams.

Hardware is listed in the last part of the Parts List. To keep our kits at the lowest possible price, we frequently weigh hardware, rather than to count it one by one. Therefore, do not be concerned if more nuts and machine screws for example, are supplied than are specified in the Parts List.

The only tools you will need are: long-nose pliers, diagonal cutters, a screwdriver, a small set-screw driver, and a soldering iron.

Building your KNIGHT 20,000 ohms per volt VOM will be easier if you study all of the diagrams and instructions before assembly is started.

The pictorial diagrams show the actual location of all parts and wiring. The KNIGHT VOM will work best when all parts are placed as shown in the diagrams. The schematic diagram shows how the parts are connected electrically, and is useful in understanding how the instrument works.

These step-by-step instructions were prepared while actually building the KNIGHT VOM. They are the best and fastest way of assembling this unit. May we suggest that you check off each step after you have completed it. Some builders also put a pencil mark on the wiring views along the leads and parts that they have just installed.

Both of these methods are good and will assure speedy and correct wiring.

WIRING AND SOLDERING

The quality of workmanship in test equipment will often determine whether an instrument will be an accurate and reliable service tool. While these wiring and soldering hints will be more helpful to a beginner in electronics, the more experienced builder may also benefit by reviewing them.

Make good mechanical connections at joints, clean metal to clean metal. Loop the wires around the switch, other connection terminals, and clamp tight.

Cut the excess lengths of all end leads of the resistors when they are soldered. When a solder connection is made close to one of the precision resistors, hold the jaws of a pair of long-nose pliers on the lead between the tip of the soldering iron and the resistor to conduct the heat away from the resistor. Arrange the long wire leads to lay close to the panel.

USE ONLY ROSIN CORE SOLDER. Use the rosin core solder supplied with the kit as KITS WIRED WITH ACID CORE SOLDER OR ACID FLUX WILL CORRODE and WILL NOT WORK FOR LONG. SUCH KITS ARE NOT ELIGIBLE FOR REPAIR OR SERVICE.

The soldering iron tip must be well tinned. First, clean the tip with steel wool or a fine file until the bright copper

shown in Figure 6 and on the label. The large "C" battery, B-1, fits into the space shown by the dotted lines on the label. The positive end of this battery must be toward the left.

( ) Install the small penlite batteries, B-2, B-3, B-4, and B-5, as shown. The positive end of B-2 and B-4 must be toward the right. The positive end of B-3 and B-5 must be toward the left.

( ) Place the battery retaining strap over the two screws which come through the battery board. Use two of the small nuts to fasten the retaining strap.

See Figure 7.

Mount the Function switch, S-1, on the panel. The locking pin of S-1 fits into the small hole at the base of the meter. Use the other large nut to fasten S-1.

Connect the other end of the 2 inch red lead from terminal 50 to terminal 2 of R-24. Solder this connection.

Connect the other end of the 4 inch yellow lead from terminal 10 of S-1 to the terminal of Jack D. Solder this connection.

Connect the other end of the 7 inch violet lead from terminal 41 of S-1 to terminal 4 of the battery clip board. Solder this connection.

Connect the other end of the 3 inch orange lead from terminal 28 of S-1 to the terminal of Jack E. Solder this connection.

Connect the other end of the 2 inch red lead from terminal 32 of S-1 to the terminal of Jack C. Solder this connection.

Connect the other end of the 9 inch white lead from terminal 34 of S-1 to terminal 1 of the battery clip board. Solder this connection.

Connect the other end of the 6 inch blue lead from terminal 38 of S-1 to terminal 10 of the battery clip board. Solder this connection.

Connect the other end of the 5 inch green lead from terminal 42 of S-1 to the positive (marked with the plus sign on the label), terminal of the meter. Solder this connection.

Check all of the work. Every connection should be strong mechanically and all should now be well soldered.

You have finished wiring your KNIGHT 20,000 Ohms per Volt VOM kit. Check the wiring very carefully. A few extra minutes spent in checking can save hours of trouble shooting.

( ) Push the large knob on the shaft of S-1. Tighten the set screw of the knob against the flat on the shaft.

( ) Push the small knob on the shaft of R-24. Tighten the set-screw.

HOW TO TEST YOUR KNIGHT VOM

Your KNIGHT VOM is precalibrated by the use of R-3, the meter calibrating resistor which has been matched to the meter movement supplied in your kit, and R-8 and R-9, the two rectifier calibrating resistors which have been matched to the rectifier supplied with your kit.

Remove the 1.5 volt "C" battery, B-1. It will be used to check the voltage ranges of your VOM.

Set the range switch at 2.5 volts DC.

Insert the black test lead into the jack marked "Com".

Insert the red test lead into the jack marked "V-ohm-A".

Zero the meter if the indicator needle does not rest directly over the zero on

the scale. Use a small screwdriver to turn the adjustment screw, which is immediately above the OFF position of the switch, until the needle is in the correct position.

Touch the probe tip of the red test lead to the positive end of the 1.5 volt "C" battery, B-1.

Touch the probe tip of the black test lead to the negative end of B-1.

The meter should read 1.5 volts.

Turn the range switch to the 10 volt DC scale.

On this scale the meter should read 1.5 volts also, but the deflection of the needle will be smaller.

Turn the range switch to the 50 volt DC scale.

The meter will read 1.5 volts on this scale, too, however, the needle deflection will be very small.

There will not be much deflection if you check the 250, 1000, 5000 volt scales with the "C" battery.

( ) Install the "C" battery, B-1, on the battery clip board again.

( ) Push the handle mounting studs through the hole in each end of the handle. Insert the stud through the hole in the meter case on one side. Use a shakeproof washer and one of the larger hex nuts to fasten the handle. Insert the other stud through the hole in the other side of the case. Use the other shakeproof washer and hex nut to fasten it.

( ) Mount the meter panel on the case. Tuck in all of the leads.

( ) Insert one of the 3/4 inch small machine screws in each corner of the panel. Tighten these screws into the tapped holes in the corners of the case.

Set the range switch to the 250 volt AC scale.

Insert the probe tips into the receptacles of a wall outlet. Hold the insulated part of the probe and do not touch the tips. The meter should read between 110 and 120 volts depending upon the line voltage in your area. You may find that the line voltage will vary at different times of the day.

Set the range switch to 1000 volts AC. The reading on the meter will be between 110 and 120 on this scale.

HOW TO CHECK THE OHMMETER

Insert the black test lead into the jack marked "Com", common.

Insert the red test lead into the jack marked "V-ohms-A".

Set the range switch at XI and touch the probe tips together. The needle should swing all the way over to zero.

Adjust the OHMS ADJUST knob to bring the needle directly above the zero on the scale.

Set the range switch at X100 and touch the probe tips together. Again the needle should swing all the way over to zero. Adjust the OHMS ADJUST knob again so that the needle zeros correctly.

Set the range switch at X10K and touch the probe tips together. The needle should swing all the way over to zero. Adjust the OHMS ADJUST knob until the needle zeros correctly.

SERVICE HINTS

If you have followed all the previous instructions carefully your KNIGHT 20,000 ohms per volt VOM should operate properly. If it does not perform properly under the tests outlined, here are some helpful hints.

If the DC voltage ranges do not operate properly, or are inoperative, check all connections to and the placement of R-19, 45K ohm; R-20, 150K ohm; R-21, 800K ohm; R-22, 4M; and R-23, 15M; resistors.

If the AC voltage ranges operate improperly, or are inoperative, check all connections to CR-1, the rectifier, and all connections to and the placement of R-4, 3.75M; R-5, 1M; R-6, 200K; R-7, 37.5K; and R-8 and R-9 the rectifier calibrating resistors.

If the ohmmeter ranges do not operate correctly, or are inoperative, check all of the connections to and the placement of R-17, 100K ohm; R-18, 80 ohm; and R-19, 45K ohm resistors.

If the milliammeter ranges do not operate properly, or are inoperative, check the connections to and the placement of R-11, 25.1 ohm wirewound resistor; R-12, 2.5 ohm wirewound resistor; R-13, .225 ohm wirewound resistor; and R-15, 11.0 ohm wirewound resistor.

Should it be necessary to replace R-3, the meter calibrating resistor, please include with your order the four numbers written on the tape on the back of the meter movement. This determines the value of R-3.

In the unusual case where it would be necessary to replace CR-1, the meter rectifier, or R-8 or R-9, the rectifier calibrating resistors, please order another rectifier and we will include the proper value of calibrating resistors with it.

If the meter still does not function properly, have someone else check your wiring, preferably someone with radio experience.

USING YOUR VOM

SPECIFICATIONS

D-C Voltmeter:	0-2.5, 10, 50, 250, 1000 and 5000 volts sensitivity 20,000 ohms per volt.
A-C Voltmeter:	0-2.5, 10, 50, 250, 1000 and 5000 volts sensitivity 5000 ohms per volt.
Ohmmeter:	To 20 megohms in 3 scales with center scale values of 12, 1200 and 120,000 ohms, respectively.
D-C Milliammeter:	0-0.1, 10 and 100 milliamperes.
D-C Ammeter:	0-1, and 10 amperes,
Accuracy:	Within ± 2% of full scale on all ranges.
Meter:	4-1/2 inches, 50 μa full scale.
Batteries:	1 flashlight, type C (1" dia. x 1-15/16). 4 flashlight, "penlite" type (37/64 dia. x 2").
Size:	6-3/4" high, 5-1/4" wide, 3-3/4" deep, including knob.

FUNCTIONS

Type of Measurement	Ranges	Type of Measurement	Ranges	
DC VOLTS ("DC V")	0 - 2.5	DIRECT CURRENT ("MA")	0 - 0.1 ma	
	0 - 10		0 - 10 ma	
	0 - 50		0 - 100 ma	
	0 - 250		0 - 1 a	
	0 - 1000		0 - 10 a	
	0 - 5000	RESISTANCE ("Ω")	X1	12 ohms mid scale
			X100	1200 ohms mid scale
			X10K	120K ohms mid scale
AC VOLTS ("AC V")	0 - 2.5	DECIBELS ("AC V")	AC Range 0 - 2.5	DB Range -30 to + 3 db
	0 - 10		0 - 10	-18 to +15 db
	0 - 50		0 - 50	- 4 to +29 db
	0 - 250		0 - 250	+10 to +43 db
	0 - 1000		0 - 1000	+22 to +55 db
	0 - 5000		0 - 5000	+30 to +63 db

With your KNIGHT VOM you can perform a very great variety of measurements. The different measurements are selected (a) by different panel jacks into which the test leads are inserted and (b) by the position of the Function Switch. A number of scales on the meter allow proper readings for any range of any function provided. The Function Switch has 18 positions and 2 decks. This makes it possible to connect the different components of the instrument so that d-c and a-c voltages, direct and alternating currents, and resistances can be measured. The meter has a highly sensitive 50-ua moving coil permanent magnet movement. A calibrating resistor (R3) assures the highest degree of accuracy of the dial indications. The meter serves as the indicator for all measurements. It has separate scales for a-c voltage, d-c voltage, decibels, resistance and current.

Preliminary Adjustments

Before any measurements are made, be sure the instrument is placed squarely on a bench where the measurement is to be performed. Always check that the meter pointer is lined up with the zeros on the left hand side. If the pointer does not fall in line with these marks, turn the bakelite screw directly above the word "OFF" either left or right until pointer is positioned correctly.

Another reminder before using the meter for a particular type of measurement is to make certain that the operator understands fully how to handle this instrument, as well as its capabilities. With this in mind, the following paragraphs are written, to give an outline on how to use the KNIGHT VOM to your best advantage.

How to Measure D-C Voltages

Caution: Wherever possible, disconnect power from the equipment under test before connecting the meter. In cases where it is impossible to do this, connect the leads separately and use only one hand at any one time. Grasp the test prod well back from the metal tip and make momentary contact with the circuit under test by letting the metal tip of the prod touch the point at which the potential exists. Never touch any part of the equipment under test with the other hand.

Plug the black test lead into the "COM" jack and the red test lead into the "V. , .A" jack. First touch the probe end of the black (negative) test lead to the negative side of the circuit to be checked. Then, leaving one hand free, touch the red (positive) test probe to the positive terminal of the circuit to be tested.

It is a good practice always to start with the highest range available, as a protection for your meter. Then, after first indication, the switch should be reset to the position in which more accurate readings can be obtained. If possible, make final readings on a range on which the indication is in the right hand half of the scale, because meter accuracy is based on full scale value.

Turn the power on and observe the meter deflection. (If the pointer deflects to the left instead of to the right, turn the power off and switch the connections of the red and black test leads around.)

The value of the measured voltage can now be read from the appropriate meter scale, taking into account the range setting of the Function Switch. Read on the meter scale whose extreme right-hand marker is labeled with the full-scale value indicated by the Function Switch or some multiple or submultiple of it. For d-c voltage readings, use only the black scales marked "DC".

For the 0-2.5 v d-c range use the 250 v d-c scale. Divide meter scale reading by 10. Each minor scale division equals 0.05 v d-c.

For the 0-10 v d-c range use the 10 v d-c scale. Read scale directly. Each minor scale division equals .2 v d-c.

For the 0-50 v d-c range use the 50 v d-c scale. Read scale directly. Each minor scale division equals 1 v d-c.

For the 0-250 v d-c range use the 250 v d-c scale. Read scale directly. Each minor division equals 5 v d-c.

For the 0-1000 v d-c range use 10 v d-c scale. Multiply scale reading by 100. Each minor scale division equals 20 v d-c.

For the 0-5000 v d-c range use 50 v d-c scale. Multiply reading by 100. Each minor scale division equals 100 v d-c.

If d-c voltages in excess of 1000 v but less than 5000 v are to be measured, the red test lead has to be plugged into the "5000 V DC" jack. If working with high potentials of this order, make doubly sure that the Caution paragraph at the beginning of this section is strictly observed.

How to Measure A-C Voltages

NOTE: Follow same precautions as under "Caution" in above section "How to Measure D-C Voltages."

Plug the black test lead into the "COM" jack and the red test lead into the "V. Ω .A" jack. Clip the probe of the black test lead to one terminal of the potential to be measured and the probe end of the red test lead should be touched to the other terminal of the potential.

Always start with the highest "AC V" range available, as a protection for your meter. Then after obtaining the first indication, reset the Function Switch to the position in which a convenient meter reading, preferably in the upper half of the scale, is obtained.

Turn the power on and observe the meter deflection. The value of the measured voltage can now be read from the appropriate meter scale taking into account the range setting as indicated by the Function Switch.

For the 0-2.5 v a-c range use 2.5 v a-c scale. Read scale directly. Each minor scale division equals 0.05 v a-c.

All other a-c voltage scales are chosen and read in the same way as the d-c scales discussed in the previous section, except that the red "AC" scales are used.

If a-c voltages in excess of 1000 v, but not higher than 5000 v a-c are to be measured, the red test lead has to be plugged into the "5000 V AC" jack. If working with high potentials of this order, be doubly sure that the Caution at beginning of previous section is strictly observed.

A-C voltage measurements can be made at any frequency from 25 cps through the audio range. At higher frequencies, shunting capacitance in the rectifier causes readings to become increasingly low.

How to Measure D-C Resistances

Caution: Before making any resistance measurements in a circuit, make certain that the power is turned off. It is also advisable to discharge any capacitors in the part of the circuits in which resistance measurements are to be made.

Turn the Function Switch to one of the "Ω" positions. Plug the black test lead into the "COM" jack and the red lead into the "V. Ω .A" jack. Connect the prod ends of these two test leads together. Turn the "Ω ADJ" knob until meter reads full scale deflection, at which the pointer lines up with zero on the ohms scale.

Turn Function Switch to such "Ω" position that the meter will read somewhere in, or as near as possible to, the center portion of the scale when the measurement is made. Recheck if the meter deflects full scale when the two test lead probes are connected together.

Connect the test prods respectively to the terminals of the resistance to be measured and observe the meter reading. After any change of ranges, the "Ω ADJ" should be rechecked. The value of the measured resistance can be determined by multiplying the ohms scale meter reading by the factor indicated by the Function Switch knob.

The following paragraph shows the d-c resistance range covered, and the center-scale reading for each Function Switch setting.

If the Function Switch is in "Ω X1" position, the 0-1 K ohm range is covered; center scale reading is 12 ohms. Read scale directly. If the Function Switch is in the "Ω X100" position, the 100 ohms - 100 K ohms range is covered. Center scale reading is 1200 ohms. Multiply scale reading by 100. If the Function Switch is in the "Ω X10 K" position, the 10 K - 10 Meg range is covered. Center scale reading is 120 K ohms. Multiply scale reading by 10,000.

It always should be kept in mind that in the measurement of resistance a current is made to flow through the unknown resistance. Usually this current is so small that it can be neglected. However on the lowest ohms range (X1) the half-scale reading is 12 ohms. That means a current of 65 milliamperes is flowing through the unknown reaistor. If lower resistances than 12 ohms are measured, the current through them may be as high as 130 ma. Therefore it is good practice to consider the current flow first when measuring the d-c resistance of a device which can safely pass only low currents without burning out. For all other cases no damage will result as long as the ohmmeter current does not exceed the current rating of the unknown resistance.

How to Measure Direct Current

Never connect the test leads across any source of voltage directly when the VOM is used as a current meter, otherwise the meter will be damaged. Instead, always connect the meter in series with the load. Plug the black test lead into the "COM" jack and the red lead into the "V. Ω .A" jack.

Turn the Function Switch to any "MA" or "A" position appropriate. It is good practice to start with highest range and then reset switch to obtain a convenient reading.

If currents in the order of 1 to 10 amperes are to be measured, the red lead has to be plugged into the "10 A" jack. Open the circuit in which the current is to be measured. Connect the black test lead probe to the negative side of the circuit break, and the red test lead probe to the positive side.

Connect the circuit under test to its power source. The resulting meter deflection is in a direct proportion to the unknown current. To find the magnitude of the current, the meter reading has to be multiplied by the factor indicated by the Function Switch. The listing below gives the different ranges covered, the scale on which the meter reading is done, and the multiplication factor of each current range.

For 0-0.1 ma range use the "DC 10" scale. Divide meter scale reading by 100. Each minor scale division equals 0.002 ma.

For 0-10 ma range use the "DC 10" scale. Read meter scale directly. Each minor scale division equals 0.2 ma.

For the 0-100 ma range use the "DC 10" scale. Multiply meter scale reading by 10. Each minor scale division equals 2 ma.

For the 0-1 a range use the "DC 10" scale. Divide meter scale reading by 10. Each minor scale division equals 0.02 a.

For the 0-10 a range use "DC 10" scale. Read scale directly. Each minor scale division equals 0.2 a.

If the meter pointer is deflected to the left of the scale, the test probes are connected in wrong polarity. Turn off the power, reverse the meter lead connections, and turn on the power again.

How to Use the VOM as an Output Meter

Sometimes it is necessary to measure an a-c voltage which is superimposed on a d-c voltage. Correct measurement of the a-c component in such a case is possible by use of the OUTPUT circuit of the VOM, in which a d-c blocking capacitor is employed to keep direct current from the meter, which then indicates only the a-c voltage.

To measure voltages of this nature, plug the black test lead into the "COM" jack and the red test lead into the "OUTPUT" jack. Then proceed as indicated under "How to Measure A-C Voltages". Since the 5000 v a-c range would require a change in the red lead connection, the blocking capacitor, necessary for output measurement would not be connected in the meter circuit, therefore this a-c range can not be used for output measurements, unless d-c is kept out by an external capacitor or isolating transformer.

When a-c voltages are measured with the output meter, the impedance of the d-c blocking capacitor will have an effect on the accuracy of the meter reading. The error which occurs varies with the frequency of the applied voltage, and becomes negligible on the 50 v scale and higher. The actual voltage will then be higher than the measured value. The higher the frequency the smaller this error will become.

How to Measure Output Voltages in DB (Decibels)

A-C output voltages are often measured in units called decibels, which are used to indicate power levels in amplifiers or general telephone work. The DB scale (bottom meter scale) is based on the voltage developed across a 500-ohm line when 0.006 watts are dissipated. This voltage is a reference taken as 0 db. Such a voltage deflects the pointer to 1.73 v

a-c on the 2.5 v a-c range. Therefore, a direct meter reading in terms of decibels can be made only when the meter is connected across a 500-ohm resistive load. Otherwise only relative db measurements can be obtained. However, in a large number of cases relative measurements are appropriate, since reference conditions are defined by other factors and only relative variations are important. Frequency response to 3-db "fall-off" points is an example.

The following is the procedure to obtain a db meter indication.

Plug the red test lead into the "OUTPUT" jack, to block any d-c voltage present in circuits tested. The impedance of the capacitor can be disregarded for most applications. However, when no d-c voltage is present, the "V. Ω . A" jack might be used just as well. The black test lead is plugged into the "COM" jack.

Rotate the range switch to a high "AC V" range and work down to one which is correct for the voltage to be measured.

Connect the test prods to the point of the circuit where the measurement is to be made. The meter pointer will indicate some reading in db. If the measurement is made across a 500-ohm impedance, a reading in absolute db (with respect to 6 mw) is obtained. The final db indication is determined by the value indicated on the db meter scale plus the addition of a constant, depending on the range setting. The table at the lower right corner of the meter face will give these constants.

How to Measure Alternating Current

The a-c voltage ranges may also be used to measure alternating current at power line frequencies by simply inserting a known resistor (of low resistance and sufficient wattage to carry unknown alternating current) and measuring the voltage across it. The formula:

$$I\ (\text{Amperes}) = \frac{E\ (\text{volts})}{R\ (\text{ohms})}$$

is used to find the alternating current flowing in this circuit.

How to Measure Operating Voltages in Electronic Equipment

Operating voltages are usually measured between a given terminal and a reference point. Usually ground (chassis) is this reference point.

Reference voltage data appear in service literature in several different forms. However, in all cases the conditions for these measurements should be observed, otherwise measurements are not valid.

When the meter is connected in d-c circuits, polarity should always be observed. The black lead, connected to "COM" should always be at the low voltage points. Incorrect meter connection will not produce a usable meter reading.

Since d-c operating voltage checks will help to track down circuit breakdowns, a few examples of tube electrode voltages, which actually indicate if the circuit is functioning correctly, will be shown.

Cathode voltages are most often bias voltages, and indicate whether a tube is operating over the proper portion of its characteristic.

Screen grid voltage measurements can give indications of the functioning of the associated circuits. Very low voltages at these points may indicate a leaky bypass capacitor. Abnormally high voltages might mean a faulty dropping resistor.

Plate voltage measurements can show an open plate load resistor or transformer by the complete absence of potential. Low plate voltage indicates higher conduction than a high plate potential. If the value of the plate load resistor has a higher resistance than the meter impedance, the meter reading will not read the actual existing voltage, but a value which is somewhat lower. The suggestions given under "How to Measure D-C Voltages" should be followed in such cases.

In grid circuits, the grid leak resistors have usually a rather high resistance. The d-c voltages are also of low magnitude making it rather difficult to use a fairly high d-c voltage range to maintain a high meter resistance.

Consequently the resulting readings are not a very reliable indication. In clipper, power amplifier, and oscillator circuits, grid voltage can be measured with a 20,000 ohms per volt meter, with a minimum error occurring since the grid leak resistance values are not very high and will not be affected by the meter resistance.

In oscillators with grid leak bias, the grid voltage is proportional to the amplitude of the oscillations. Therefore variations of this voltage when tuning the oscillator indicate unequal output at different frequencies.

D-C voltages in avc or agc circuits give important clues of the operation of the receiver either when the signal is or is not received. During alignment a specified voltage has to be applied to such systems, which can be checked by a VOM connected to that line. Also overloading, with resulting stage blocking, can be checked by voltage measurement of the avc and agc systems.

The d-c voltmeter can also be used as an alignment indicator. For this purpose, connect the meter across the plate load resistor of the detector and set Function Switch until a deflection of the meter pointer results. Then proceed with the regular alignment using the meter as a peak or dip indicator.

The operation of a-c circuits in electronic equipment can also be checked by tracing the voltages applied to the different circuits. The frequency range of the VOM permits only the check of voltages up to the low audio frequencies.

For example, transformers in power supplies may be checked by connecting the meter across the different windings and comparing the measured voltages to those given as references.

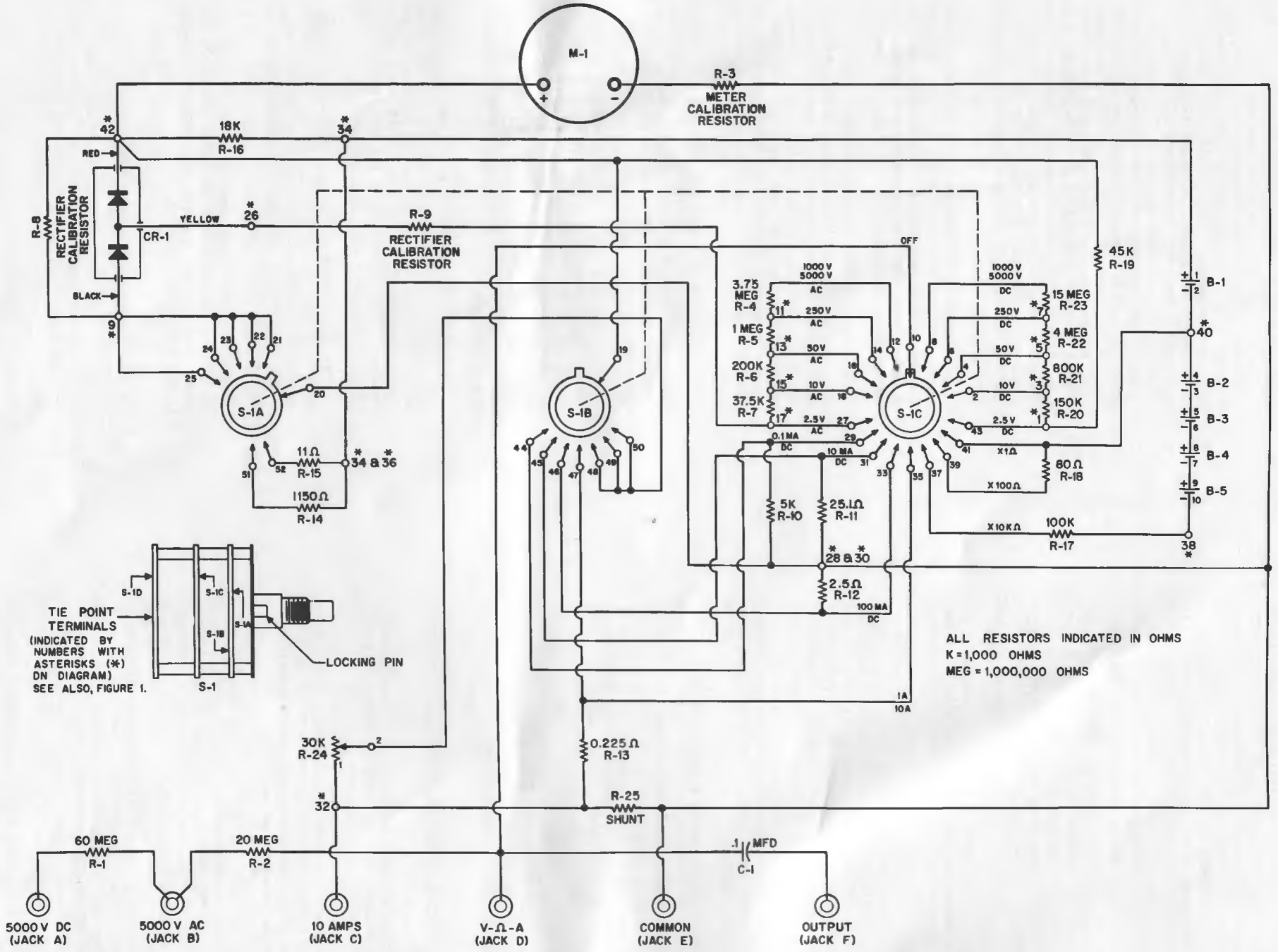

FIGURE 8. SCHEMATIC DIAGRAM. KNIGHT VOM.

SYMBOL NO.	DESCRIPTION	PART NO.
C-1	Capacitor, paper, .1 MFD 600V	247014
Note: When ordering resistors give complete description and part number.		
R-1	Resistor, 60 megohm, ± 1% precision	366005
R-2	Resistor, 20 megohm, ± 1% precision	362005
R-3	Resistor, meter calibrating (packed with the meter)	
R-4	Resistor, 3.75 megohm, ± 1% precision	343754
R-5	Resistor, 1 megohm, ± 1% precision	341004
R-6	Resistor, 200K ohm, ± 1% precision	342003
R-7	Resistor, 37.5K ohm, ± 1% precision	343752
R-8	Resistor, rectifier calibrating (smaller value)	
R-9	Resistor, rectifier calibrating (larger value)	
R-10	Resistor, 5K ohm, ± 1% precision	345001
R-11	Shunt, wirewound on blue form, 25.1 ohm, ± 1%	412517
R-12	Shunt, wirewound on yellow form, 2.5 ohm, ± 1%	410257
R-13	Shunt, wirewound on red form, .225 ohm, ± 1%	412259
R-14	Resistor, 1150 ohm, ± 1% precision	341151
R-15	Shunt, wirewound on green form, 11.0 ohm, ± 1%	410110
R-16	Resistor, 18K ohm, ± 1% precision	341802
R-17	Resistor, 100K ohm, ± 1% precision	341003
R-18	Resistor, 80 ohm, ± 1% precision	340800
R-19	Resistor, 45K ohm, ± 1% precision	344502
R-20	Resistor, 150K ohm, ± 1% precision	341503
R-21	Resistor, 800K ohm, ± 1% precision	348003
R-22	Resistor, 4 megohm, ± 1% precision	344004
R-23	Resistor, 15 megohm, ± 1% precision	351505
R-24	Potentiometer, OHMS ADJUST, 30K ohm	390116
R-25	Shunt, 10 ampere, 4.3" #14 Advance Wire, .025 ohm	334001
CR-1	Rectifier, copper oxide	621002
M-1	Meter, 50 microampere movement mounted in front panel	040002
S-1	Switch, FUNCTION, 2-deck 18-position rotary	432302
B-1	Battery, 1.5 V "C"	450011
B-2, 3,4,5	Battery, 1.5 V penlite	450013

Quantity	Description	Part No.
1 ea.	Board, battery clip	534005
1 ea.	Case	701004
2 ea.	End leads for R-25	470022
1 ea.	Handle	920005
6 ea.	Inserts, jack	532006
1 ea.	Knob, large	761301
1 ea.	Knob, small	761001
1 ea.	Label, paper, showing polarity of batteries and meter	750040
1 ea.	Manual	750041
4 ea.	Nuts, 4-36 hex	570230
2 ea.	Nuts, 10-32 hex	570540
3 ea.	Nuts, 3/8" hex	570840
6 ea.	Screws, 4-36 x 3/4" BH	560237
2 ea.	Screws, 4-36 x 3/8" BH	560234
24"	Solder, rosin core	930001
2 ea.	Spacer, 1/8"	940002
6"	Spaghetti, small	812001
4"	Spaghetti, large	812003
1 ea.	Strap, battery retaining	470050
2 ea.	Stud, handle	470025
1 set	Test leads (red & black)	040001
2 ea.	Washer, lock, #10	582500
1 ea.	Washer, lock, 3/8"	582700
1 ea.	Wire, #20 bare, 9" length	806000
5 ea.	Wire, red, 2" length	801002
3 ea.	Wire, orange, 3" length	801003
1 ea.	Wire, yellow, 4" length	801004
2 ea.	Wire, green, 5" length	801005
1 ea.	Wire, blue, 6" length	801006
1 ea.	Wire, violet, 7" length	801007
1 ea.	Wire, white, 9" length	801009

TOOLS YOU MAY NEED

Stock No.	Description	Price*
46N852	Soldering pencil	$4.73
46N449	Long-nose pliers	1.76
46N431	Diagonal cutting pliers	1.55
45N796	6" screwdriver	.72
43N831	Set-screwdriver	.27

*All Prices subject to change without notice.